

CORRES. CONTROL  
INCOMING LTR NO.

00234 RF02



Department of Energy

ROCKY FLATS FIELD OFFICE  
10808 HIGHWAY 93, UNIT A  
GOLDEN, COLORADO 80403-8209

RECEIVED

2002 APR -9 P 1:54

CORRESPONDENCE  
CONTROL

APR 04 2002

02-DOE-00527

DUE DATE  
ACTION

Mr. Steven H. Gunderson  
Rocky Flats Cleanup Agreement Coordinator  
Colorado Department of Public Health and Environment  
4300 Cherry Creek Drive South  
Denver, CO 80246-1530

Dear Mr. Gunderson:

Please find enclosed a completed Rocky Flats Cleanup Agreement Standard Operating Protocol (RSOP) for Facility Disposition notification form for Building 886 explosive demolition.

In accordance with the Facility Disposition RSOP, this letter and its enclosure are notification for RSOP implementation. This notification is for all activities required to structurally weaken the thick concrete walls and ceiling of Room 101 in Building 886 using explosives making mechanical demolition of the structure more economic and safe.

The process planned for use on the four and five-foot thick concrete walls and two-foot thick concrete ceiling will undergo explosive harmonic delamination. Harmonic delamination is a process employed by Controlled Demolitions Incorporated (CDI), a world class explosive demolition firm, whereby closely timed small explosion are used to vibrate a structure such that the cohesion of the portland cement matrix and the reinforcing steel and aggregate is loosened making mechanical demolition much easier. The structure will probably remain standing after delamination.

Please find enclosed in addition to the notification form, a schedule, and an evaluation of demolition methods that provide greater detail.

The stakeholders have been notified in both the December and March Environmental Restoration and Decontamination and Decommissioning meetings of the planned use of explosives, and a workshop going over the evaluation of demolition methods was held with the stakeholders in January. No adverse comments were received.

In that the planned shot is scheduled for April 12, 2002, expedited review and comment is requested. Questions can be directed to Steve Tower at (303) 966-2133.

Sincerely,

*Joseph A. Legare*  
Joseph A. Legare  
Assistant Manager

for Environment and Stewardship



ADMIN RECORD

B886-A-000057

DIST.	LTR	ENC
BOGENBERGER, V.		
BOGNAR, E.	X	X
BRAILS福德, M.D.		
BURNS, T. F.		
DECK, C. A.	X	X
DEGENHART, K.		
DIETERLE, S. E.	X	X
FERRERA, D.W.	X	X
FERRIL, M.S.		
GERMAIN, A. J.		
GIACOMINI, J.		
HALL, L.		
ISOM, J. H.		
MARTINEZ, L. A.	X	X
MCLAUGHLIN, J.	X	X
NORTH, K.		
PARKER, A.M.	X	X
POWERS, K.		
RAAZ, R. D.		
RODGERS, A. D.		
SCOTT, G.K.	X	X
SHELTON, D.C.	X	X
SPEARS, M.S.		
TRICE, K.D.		
TUOR, N.R.		
VOORHEIS, G.M.		
WILLIAMS, J. L.		
Gibbs, F.	X	X
MARSHALL, J.	X	X
Myers, K.	X	X
Brooks, L.	X	X

COR. CONTROL	X	X
ADMIN. RECORD	X	X
PATS/130		

Reviewed for Addressee  
Corres. Control RFP

4/9/02  
Date By *leg*

Ref. Ltr. #

DOE ORDER #

NONE

Enclosures

1/20

Mr. Steven H. Gunderson  
02-DOE-00527

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APR 04 2002

cc w/o Encs:

S. Tower, AMP, RFFO

F. Gibbs, K-H

J. Marschall, K-H

K. Myers, K-H

T. Rehder, EPA

cc w/Encs:

T130G Administrative Record

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## RSOP for Facility Disposition Checklist

<b>Project scope:</b> Buildings 886 Room 101												
<b>Facility description:</b> Building 886 Room 101												
<b>Description of planned activity(ies):</b> Structural weakening of Building 886 room 101 with the use of Harmonic Delamination Explosives												
<b>Facility/rooms/sets/areas involved:</b> Building 886, Room 101												
<b>Is RCRA unit closure(s) part of the planned activity?</b>										<input type="checkbox"/>	Yes	
<b>If RCRA units are included, attach unit specific information sheets and drawings</b>										<input checked="" type="checkbox"/>	No	
<b>RLCR Status</b>		<input checked="" type="checkbox"/>	RLCR complete and concurrence received: 12/24/1997									
		<input type="checkbox"/>	RLCR initiated but incomplete; concurrence anticipated:									
		<input type="checkbox"/>	RLC has not been initiated <sup>1</sup> and is scheduled for initiation on:									
<b>If RLCR is not complete or initiated, what data will be used to plan the work activities?</b>												
<b>Activity requires modification to the ARARs listed in the RSOP.</b>										<input type="checkbox"/>	Yes, attach to letter	
										<input checked="" type="checkbox"/>	No	
<b>Attach Administrative Record file requirements for the activity.</b>												
<b>Point of contact for each facility/activity:</b> J.R. Marschall, 303-966-2372												
<b>Duration of work activities:</b> One week						<b>Anticipated work start:</b> 4/12/02						
<b>Attach schedule for each facility or activity for information purposes. -</b>												
<b>Does the activity involve removing contaminated portions of the building shell? Include a description of the activity, contamination levels and controls</b>										<input type="checkbox"/>	Yes, LRA consultation and concurrence required	
										<input checked="" type="checkbox"/>	No	
<b>Are there deviations/exceptions to the RSOP for the proposed activity(ies)?</b>										<input type="checkbox"/>	Yes	
										<input checked="" type="checkbox"/>	No	
<b>Provide an explanation of deviation/exception to the RSOP:</b> Not applicable												
<b>C. Check the appropriate resulting action box below</b>												
<b>Additional RFCA decision document required:</b>												
<b>Major modification to RSOP</b>						<b>Field change to RSOP</b>						
<b>Minor modification to RSOP</b>						<b>LRA consultation</b>						
<b>Activity(ies) will result in the following waste types</b>										<input type="checkbox"/>	Process waste	
										<input checked="" type="checkbox"/>	Remediation waste	
<input type="checkbox"/>	TRU	<input type="checkbox"/>	LLW	<input type="checkbox"/>	LLMW	<input type="checkbox"/>	Haz.	<input checked="" type="checkbox"/>	Sanitary	<input checked="" type="checkbox"/>	Other: Concrete generated from this activity meets the definition of free-releasable as defined in the Concrete RSOP	
<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>								
<b>LRA Notification Review Time</b>				<input checked="" type="checkbox"/>	14 days, no RCRA unit closure involved							
				<input type="checkbox"/>	30 days, RCRA unit closure involved							

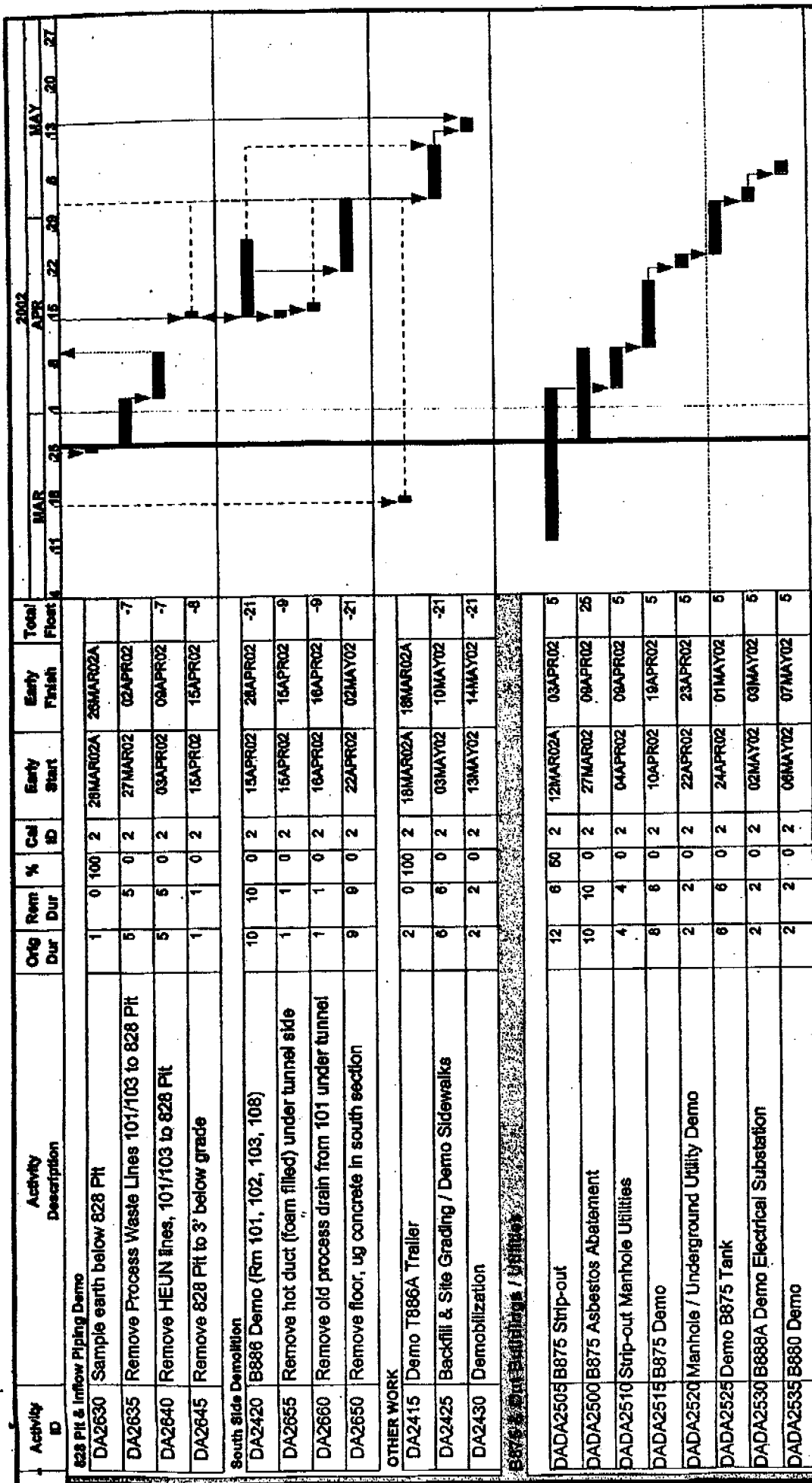
**Administrative Record Requirements for this Activity**

- Final Rocky Flats Cleanup Agreement (RFCA)
- RFETS Decommissioning Program Plan (DPP)
- RFCA Standard Operating Protocol for Facility Disposition
- Reconnaissance Level Characterization Report for the 886 Cluster Decommissioning Project
- Building 886 Interim Measure/ Interim Remedial Action Plan
- Notification Letter and attachments and subsequent CDPHE correspondence, if appropriate



Activity ID	Activity Description	Orig Dur	Rem Dur	% Cal	ID	Early Start	Early Finish	Total Float	2002											
									MAR			APR			MAY					
						11	18	25	1	8	15	22	29	6	13	20	27			
+ ROOM 101																				
		37	0	100	3	22JAN02A	28MAR02A													
+ ROOM 103																				
		18	0	100	3	25FEB02A	28MAR02A													
+ B886 Block Bldg Asbestos Abatement																				
		87	0	100	2	18NOV01A														
ROOM 104 / 108																				
DA2235	Hydrolyze floor room, 104/108	2	0	100	2	11FEB02A	12MAR02A													
DA2575	Build containment to remove ACM walls	3	0	100	2	08MAR02A	08MAR02A													
DA2580	Remove ACM Walls 104/108	1	0	100	2	08MAR02A	08MAR02A													
DA2585	Clean containment 104/108	1	0	100	2	08MAR02A	08MAR02A													
DA2590	Perform asbestos sampling	1	0	100	2	10MAR02A	10MAR02A													
DA2595	Remove containment 104/108	1	0	100	2	11MAR02A	11MAR02A													
DA2600	Remove process vent line	1	0	100	2	12MAR02A	12MAR02A													
DA2605	Cover floor in 104/108 with plastic	1	0	100	2	14MAR02A	14MAR02A													
DA2615	Dispose of hydrolyzing water & sludge	10	9	15	2	19MAR02A	08APR02	3												
DA2610	Clean rooms 104/108	1	0	100	2	27MAR02A	27MAR02A													
+ ROOM 112																				
		7	0	100	2	20FEB02A	28FEB02A													
Tunnel																				
DA2620	Build bulk head in tunnel near 886	2	1	50	2	27MAR02A	27MAR02	32												
DA2625	Strip out remainder of hot duct in Tunnel	5	4	20	2	28MAR02A	01APR02	2												
+ OTHER WORK																				
		27	0	100	3	12JAN02A	27FEB02A													
+ ROOM 101																				
		5	0	100	2	19FEB02A	23MAR02A													
+ ROOM 103																				
		4	0	100	2	19MAR02A	23MAR02A													
+ ROOM 104 / 108																				
		1	0	100	2	28MAR02A	28MAR02A													

Activity ID	Activity Description	Orig Dur	Rem Dur	% Cal	ID	Early Start	Early Finish	Total Float	2002																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
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**EVALUATION DEMOLITION METHODS**

**for**

**Building 886**

**RISS CLOSURE PROJECT**

**February 2002**

## **1. Introduction**

This evaluation appraises the potential methods for the demolition of Building 886 (Room 101) at the Rocky Flats Environmental Technology Site (RFETS). The approaches to the Room 101 demolition were evaluated based on proposals from demolition subcontractors. The demolition subcontractors were asked to evaluate Room 101 and propose the safest and most efficient means for demolishing that portion of the facility. The methods evaluated include mechanical demolition to include excavators with attachments, implosion of the structure and a combination of explosives called harmonic delamination and mechanical means.

Harmonic delamination is the combination of small amounts of high-velocity explosive charges with millisecond delays in the initiation sequence to allow for the fracturing/delamination of concrete without major displacement of debris particles or generation of excessive overpressure or vibration. Detonation waves created by small, high velocity explosive charges dissipate in the direction of least resistance. When those waves pass through an object, the waves seek superficial face via the densest component of the mass. In passage, the detonation waves cause materials of differential density (such as, aggregate or reinforcing bar) to oscillate at differential velocity compared to the cement mix surrounding those components. The differential oscillation of those components causes delamination of both aggregate and rebar from the mass, disrupting the structural force system created by the combination of concrete and rebar.

The mechanical means of demolition recommended by demolition subject matter experts for Room 101 was excavator with attachments. The wrecking ball method of demolition was not evaluated because the method is difficult to control from a health and safety and dust perspective. Cabling was not evaluated because this method would not work on a structure of this size and construction. Non-explosive cracking agent was not evaluated because it is generally used on horizontal surfaces and small areas. Diamond wire cutting was not evaluated because it is too costly and time consuming.

## **2. Evaluation Scope**

The evaluation only includes demolition activities for Room 101 and the associated hallway into Room 101 of Building 886. Activities before and after demolition are the same regardless of the demolition method. Before initiating demolition activities, the subject areas will be prepared in the following manner:

- The walls will be decontaminated
- The pre-demolition survey will be completed
- The walls will be draped in plastic to minimize the potential for cross contamination
- The slab in Room 101 will be removed through saw cutting
- The soil beneath the slab in Room 101 will be characterized and remediated, if necessary
- Confirmatory surveys will be performed on the walls to ensure that the concrete still meets the unrestricted release criteria
- The below grade opening will be plugged, capped, blind flanged or covered with protective covering, as appropriate
- The *Pre-Demolition Survey Report* will be approved by DOE and LRA
- The Demolition Plan will be completed

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The purpose of the evaluation is to determine which of the methods are viable for demolition of the Room 101. The evaluations developed by the individual subject matter experts are subjective and based on their years of experience. While many methods were considered, only a few were evaluated completely. For example, use of a wrecking ball was considered but not evaluated based on the inherent safety concerns, increased fugitive emissions, and increased amount of runoff generation due to dust suppression efforts. The methods evaluated are viable means for demolition of the structure, but certain aspects of each method may be preferable over the other methods. For example, complete implosion of Room 101 will be the fastest means of demolishing the structure and would have the least exposure to the workers for industrial hazards, but it would create more dust in a shorter period of time than mechanical means or by weakening the structure with explosives prior to mechanical demolition. This evaluation will not determine the demolition method for the subject structure, but the evaluation will be used by the decision-makers to understand all of the benefits or ramifications prior to making a decision.

## **2.1. Building 886**

The continued presence of large quantities of fissile material in numerous forms at the Rocky Flats Plant made it necessary to maintain an active criticality safety program. A Nuclear Safety Group was formed in 1953 to perform the criticality experiments. Once Building 886 was commissioned, the Nuclear Safety Group conducted its work there. Since that time, the Nuclear Safety Group conducted about 1,700 critical mass experiments using uranium and plutonium in solutions, compacted powder, and metallic forms. Building 886 housed the Critical Mass Laboratory, and was operated from 1965 until 1987.

Building 886 is rectangular structure with a shallow-pitched gabled roof. Two shed-roof wings extend from its northeast and southeast corners. A 37-foot tall concrete windowless building (Room 101) is attached to the south. A temporary pre-fabricated trailer housing offices is attached to the northeast wing by a breezeway. Building 886 is 10,360 square feet on a single level.

Building 886 consists of three areas: the Radiological Area; office space; and a small electronics and machine shop. The Radiological Area is comprised of three rooms and a hallway. Almost all criticality experiments were conducted in Room 101, the assembly room. The walls are reinforced concrete, greater than or equal to 4 feet thick and the ceiling is 2 feet thick. Room 102, a storage vault, was constructed in the mid-1970s to meet the Department of Energy requirements for a Special Nuclear Material Vault. Both rooms, 101 and 102, have double reinforced concrete walls integrally cast to the ceiling. Room 103, the Mixing Room, was a fissile solution storage area; three walls are reinforced concrete, and the west wall is cinder blocks. The remainder of the load bearing walls in Building 886 are constructed of cinder blocks. The exterior wall of Room 102 is also lined with cinder block.

Currently, Kaiser-Hill Construction is conducting the Building 886 decommissioning. The general sequence of activities for the Building 886 Project decommissioning is:

- Isolate power to Building 886
- Install temporary power
- Strip-out office areas and radiological areas inside Building 886

- Flush, isolate, cap traps and sanitary sewer lines
- Abate asbestos
- Decontaminate structure
- Partially remove HVAC system
- Perform pre-demolition survey
- Place plastic on the walls around Room 101 and around the sump in Room 103
- Remove slab in Room 101 and sump in Room 103
- Complete ventilation removal
- Characterization and remediate soil, as necessary
- Perform confirmatory surveys
- Plug the tunnel opening
- Demolish structure
- Remove tunnel to three feet below grade and backfill

The floor in Room 101, contains trenches for electrical conduit that were filled with concrete and are expected to contain contamination. The trenches will be removed along with the section of floor that encapsulates the ventilation exhaust duct feed for Room 101. Previous coring inside Room 101 reveals a variation in depth from 8 inches on the south side of Room 101 to 20 inches on the northwest. On the south side of Room 103, a pit area exists that housed storage tanks during facility operation (tanks were previously removed). Previous coring of the Room 103 Pit Area reveals the floor slab to be 8 inches in depth and the cores contained volumetric contamination.

Before removing the slab, Rooms 101 and 103 will be decontaminated and the pre-demolition surveys will be performed. The walls will be covered with flame retardant plastic to minimize the potential for cross contamination. Verification surveys will be conducted after the slab removal and soil characterization and remediation are complete to ensure that the walls have not been contaminated during the activity.

The contaminated concrete floors will be removed utilizing mechanical methods (i.e., jackhammers, pulverizing equipment) or an approved concrete cutting Subcontractor. Additional sampling performed in Room 102 indicates a limited amount of surface contamination. Therefore, the floor in Room 102 will be hydrolased to remove any surface contamination, as well as removing the paint for direct access to the floors to meet the requirements of the Pre-Demolition Surveying Checklists.

This evaluation specifically addresses the demolition of the walls around Room 101 and the hallway into Room 101. The load bearing walls are 4 feet thick, with the exception of a portion of the immediate hallway to Room 101, which is 5 feet thick. All walls are double reinforced with steel/re-bar. The ceilings are 2 feet thick and double reinforced.

In accordance with the Integrated Monitoring Plan, the Industrial Area RAAMP monitors will switch to a weekly filter collection a week before the Building 886 demolition is initiated and continue until a week after the demolition is complete. A hypothetical release of 1 curie U-234

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was modeled with CAP88-PC using the meteorological data from 2001 that indicated that Sampler 119 was the most impacted and Sampler 212 was the second most impacted. Sampler 119 is approximately 343 meters east of Building 886, and Sampler 212 is approximately 623 meters east-southeast of Building 886.

### **3. Evaluation Summary**

Table 1 contains the demolition method evaluation for the Room 101 in Building 886 with explosives versus mechanical means. The following sections summarize the results of the evaluation of demolition techniques for Room 101. In addition, each section indicates the preferred method for demolition with respect to the criteria. The decision on what demolition method will be used for the Room 101 in Building 886 will not be made by this evaluation, but the evaluation will be used by the decision-makers.

#### **3.1. Health and Safety Evaluation**

A certified safety professional developed the activities, hazards, and controls associated with each method of demolition, and using that information, determined the positive and negative aspects of each method from a health and safety perspective. The demolition methods were evaluated assuming the hazards were not mitigated using a risk assessment code methodology. From a health and safety perspective, all of the hazards can be controlled thereby reducing the risk, which is why the methods are evaluated without the controls. Assuming the appropriate controls are in place, all demolition methods are essentially equivalent from a worker health and safety perspective. Both demolition methods using explosives have a shorter duration, statistically lowering the potential for incidents, which is why those methods are slightly more preferred.

#### **3.2. Environmental**

An environmental subject matter expert outlined the potential impacts associated with each method of demolition, and using that information, determined the positive and negative aspects of each method from an environmental perspective. In general, the demolition methods involving explosives had more positive/acceptable impacts than the straight mechanical demolition. The categories that differentiated the methods were soils and geology, air quality, water quality, human health and safety, and noise. The primary reason the methods involving explosives had more positive/acceptable impacts was primarily due to the decreased duration of project activities. None of the methods have significant environmental impacts.

#### **3.3. Structural**

An engineer evaluated the effectiveness of each method of demolition, and using that information, determined the positive and negative aspects of the effectiveness of the each method. The structural evaluation indicates that all of the demolition methods evaluated are viable demolition techniques. The combined explosive and mechanical method evaluated slightly better than the other two methods because dropping the structure to the ground and then mechanically busting up the larger rebar-free sectional pieces with much more direct access than the straight mechanical method, also allows for more absolute dust control via a hose stream than the implosion method. Overall, harmonic delamination and the excavator demolition method is the most efficient, is inherently safer, and has the best opportunity for dust control.

#### **3.4. Economic**

The economic evaluation was based on fixed priced estimates provided by the subcontractors. The cost and duration for mechanical demolition are presented as ranges because walls of this thickness have not been demolished at Rocky Flats. The low end of the range represents the cost if everything goes perfectly, and the high end of the range represents a worse case scenario. An average was used to evaluate this cost against the other proposed methods. Costs associated with removing the material after demolition were not included due to those costs being required and necessary regardless of method used. The economic evaluation indicates that mechanical demolition is the most cost-effective method, although the range of the costs is insignificant.

Table 1. Demolition Evaluation<sup>1</sup>

Project Description <sup>2</sup>	Mechanical Demolition	Explosive Implosion	Harmonic Delamination and Mechanical Demolition
	<p>The project area will be set up with at least a 100-foot radius around the building. Only authorized personnel will be allowed in this area.</p> <p>Two 345 excavators with process/shear attachments will be use to systematically demolish the structure. One of the excavators will have a hoe ram to break apart the thick walls and the other excavator will manage the pieces. In addition to the two equipment operators, a spotter will be required and two laborers operating hoses for dust control.</p> <p>During demolition activities, engineering controls will be implemented to limit dust. Water will be used as an engineering control to prevent dust levels from exceeding the OSHA PEL. Laborers will spray the demolition debris with water while the demolition activities are being performed.</p> <p>The duration of the demolition is three to four weeks.</p>	<p>The project area will be set up with at least a 100-foot radius around the building. Only authorized personnel will be allowed in this area.</p> <p>In order to implode room 101, approximately 53 holes will be drilled and approximately 12 pounds of explosive will be placed in each hole. The affected part of the building will be wrapped in 2 layers of 9-gauge wire fabric intertwined with 2 layers of 12-ounce geotextile fabric to minimize flying projectiles, approximately 600 lbs of explosives (NONEL) would be used.</p> <p>Dust control measures would be utilized during drilling activities with a filter system on the drill. The streets around the area would be swept after the post-implosion.</p> <p>The drilling could be completed in 11 days during the lag time for the pre-demolition survey approval and the actual demolition could be completed in 2 days.</p>	<p>The project area will be set up with at least a 100-foot radius around the building. Only authorized personnel will be allowed in this area.</p> <p>Harmonic delamination of Room 101 and removal of the roof will consist of drilling vertical holes, approximately 3.5-4 lineal feet for each cubic yard of concrete, and loading explosives in those holes. The roof will be removed with explosives before blasting the walls; it will be removed in quarters. Once the holes are drilled in the walls, exterior surfaces will be covered with one or more layers of chain link fence fabric and geotextile fabric.</p> <p>The fracturing of the walls will be conducted in no less than 4 and no more than 10 production delamination operations.</p> <p>A test shot will be required to determine the amount of explosives required. It is anticipated that less than 500 pounds of Exgel will be required.</p> <p>A Durapulse dust collector and water palletizing system will be used during drilling operations - a study indicates it cuts emissions by 92%.</p> <p>During blasting, the geotextile placed on the walls will be wet and water will be placed on the roof to control dust.</p> <p>The drilling could be completed in 11 days during the lag time for the pre-demolition survey approval, the harmonic delamination could be completed in 1 day, and actual demolition with an excavator could be completed in 4 days.</p>

<sup>1</sup> Each area evaluated, has a narrative row followed by an evaluation of the criteria: + is a positive aspect, 0 is a neutral aspect, and - is a negative impact, indicating the ranking of hazards, impacts, or acceptability

<sup>2</sup> The project descriptions are based on proposed demolition processes; the actual processes may differ slightly and will be documented in the Demolition Plan

Table 1. Demolition Evaluation<sup>3</sup>

Health and Safety	Mechanical Demolition	Explosive Implosion	Harmonic Delamination and Mechanical Demolition
	<p>Qualitative assessment of this demolition method is considered to have an average overall medium/high risk to Site workers, personnel, equipment, and property if hazards are not properly mitigated. However, when proper engineering, administrative, and PPE controls are implemented, the average overall risk is considered to be low. Major potential hazards/sources identified for the major operations include the following:</p> <ul style="list-style-type: none"> <li>• Contact w/electrical</li> <li>• Struck by moving vehicles</li> <li>• Caught between/pinch points</li> <li>• Contact with sharp objects</li> <li>• Contact with petroleum product (hydraulic fluid)</li> <li>• Overexertion from material handling</li> <li>• Struck by (debris, re-bar)</li> <li>• Exposure to dust (concrete)</li> <li>• Exposure to noise (breaker)</li> <li>• Equipment accident (heavy equipment)</li> </ul>	<p>Qualitative assessment of this demolition method is considered to have an average overall medium/high risk to Site workers, personnel, equipment, and property if hazards are not properly mitigated. However, when proper engineering, administrative, and PPE controls are implemented, the average overall risk is considered to be low. Major potential hazards/sources identified for the major operations include the following:</p> <ul style="list-style-type: none"> <li>• Fall from elevation (roof)</li> <li>• Contact w/electrical (drill)</li> <li>• Contact w/ sharp objects (drill bit)</li> <li>• Struck by debris (concrete)</li> <li>• Falling debris below (concrete)</li> <li>• Exposure to dust (drill, explosion)</li> <li>• Exposure to noise (drill, explosion)</li> <li>• Overexertion from material handling (equipment)</li> <li>• Unplanned detonation (explosives)</li> <li>• Unplanned structural collapse (walls)</li> <li>• Fall on same level (debris, re-bar)</li> </ul>	<p>Qualitative assessment of this demolition method is considered to have an average overall medium/high risk to Site workers, personnel, equipment, and property if hazards are not properly mitigated. However, when proper engineering, administrative, and PPE controls are implemented, the average overall risk is considered to be low. Major potential hazards/sources identified for the major operations include the following:</p> <p><b>Harmonic Delamination</b></p> <ul style="list-style-type: none"> <li>• Fall from elevation (roof)</li> <li>• Contact w/electrical (drill)</li> <li>• Contact w/ sharp objects (drill bit)</li> <li>• Struck by debris (concrete)</li> <li>• Falling debris below (concrete)</li> <li>• Exposure to dust (drill, explosion)</li> <li>• Exposure to noise (drill, explosion)</li> <li>• Overexertion from material handling (equipment)</li> <li>• Unplanned detonation (explosives)</li> <li>• Unplanned structural collapse (walls)</li> <li>• Fall on same level (debris, re-bar)</li> </ul>

<sup>3</sup> Each area evaluated, has a narrative row followed by an evaluation of the criteria: + is a positive aspect, 0 is a neutral aspect, and - is a negative impact, indicating the ranking of hazards, impacts, or acceptability

<sup>4</sup> Reference H&S Risk Assessment - 886 Demolition 1/31/02

Table 1. Demolition Evaluation<sup>5</sup>

Health and Safety <sup>6</sup>	Mechanical Demolition	Explosive Implosion	Harmonic Delamination and Mechanical Demolition
	<p>Major controls include the following:</p> <ul style="list-style-type: none"> <li>• Work control document</li> <li>• Job Hazard Analysis</li> <li>• Pre-evolution Briefings &amp; Awareness</li> <li>• Use of trained and qualified personnel</li> <li>• De-energizing electrical power</li> <li>• Establish exclusion zones</li> <li>• High visibility vests</li> <li>• PPE</li> <li>• Dust suppression</li> </ul>	<p>Major controls include the following:</p> <ul style="list-style-type: none"> <li>• Work control document</li> <li>• Job Hazard Analysis</li> <li>• Pre-evolution Briefings &amp; Awareness</li> <li>• Use of trained and qualified personnel</li> <li>• De-energizing electrical power</li> <li>• Establish exclusion zones</li> <li>• High visibility vests</li> <li>• PPE</li> <li>• Dust suppression</li> </ul>	<p><b>Mechanical Demolition</b></p> <ul style="list-style-type: none"> <li>• Contact w/electrical (O/H power lines)</li> <li>• Struck by moving vehicles (heavy equipment)</li> <li>• Caught between/pinch points (attachment and boom)</li> <li>• Contact w/ sharp objects (equipment)</li> <li>• Contact with petroleum product (hydraulic fluid)</li> <li>• Overexertion from material handling (equipment)</li> <li>• Struck by (debris, re-bar)</li> <li>• Exposure to dust (concrete)</li> <li>• Exposure to noise (breaker)</li> <li>• Equipment accident (heavy equipment)</li> </ul>
Overall Risk to Site Workers, personnel, equipment, and property	0 <sup>7</sup>	+ <sup>8</sup>	+ <sup>8</sup>

Major controls include the following:

- Work control document
- Job Hazard Analysis
- Pre-evolution Briefings & Awareness
- Use of trained and qualified personnel
- De-energizing electrical power
- Establish exclusion zones
- High visibility vests
- PPE
- Dust suppression

<sup>5</sup> Each area evaluated, has a narrative row followed by an evaluation of the criteria: + is a positive aspect, 0 is a neutral aspect, and - is a negative impact, indicating the ranking of hazards, impacts, or acceptability

<sup>6</sup> Reference H&S Risk Assessment - 886 Demolition 1/31/02

<sup>7</sup> Overall, the use of an "Excavator with Attachments" may take a longer period time and require some workers to be in closer proximity to the demolition. Because of this and the fact that method's average overall mitigated risk rating was low, this method was given a neutral (0) aspect rating.

<sup>8</sup> It is estimated that use of this method would save approximately 3-4 weeks off the project schedule and, in turn, further mitigates potential risk exposures to Site workers, personnel, equipment, and property. Based on this, this method was given a positive (+) aspect rating.

Table 1. Demolition Evaluation<sup>9</sup>

	Mechanical Demolition	Explosive Implosion	Harmonic Delamination and Mechanical Demolition
Environmental	<p>This method has medium environmental impacts:</p> <ul style="list-style-type: none"> <li>Impacts to air quality: an operator wetting the structure with a fire hose will control fugitive dust. This will result in more dust generation during the lengthy demolition process. Vehicle and equipment emissions will be higher with this method due to the duration.</li> <li>Impacts to surface water quality may occur, such as runoff generated during and after dust control.</li> <li>Some impacts to soils are expected from dust control, the falling structure and vehicular traffic. No soil contamination is expected, as the facility will meet the unrestricted release criteria prior to demolition.</li> <li>No impacts to wildlife are expected. Efforts will be taken to cordon off the area to wildlife.</li> <li>This method may generate additional incidental waste (i.e., trash) during demolition due to the duration. It is expected to take three to four weeks.</li> <li>Resource use is increased by this method due to the demolition duration.</li> </ul>	<p>This method has minimal environmental impacts.</p> <ul style="list-style-type: none"> <li>Impacts to air quality: fugitive dust will be controlled by a filter system during drilling and a street sweeper and hoses after demolition. Vehicle and equipment emissions are less with this method due to the one-day duration.</li> <li>Impacts to surface water quality may occur, such as runoff generated during and after dust control.</li> <li>Minimal impacts to soils are expected from the falling structure. No soil contamination or erosion impacts are expected, as the facility will meet the unrestricted release criteria prior to demolition.</li> <li>No impacts to wildlife are expected since the building is in the industrial area. However, efforts will be taken to cordon off the area to personnel and wildlife.</li> <li>This method will generate little additional waste (chain link or geotextile containment only) when compared to the mechanical methods.</li> <li>Resource use is minimized by this method, as the demolition duration is limited to one day.</li> </ul>	<p>This method has medium environmental impacts.</p> <ul style="list-style-type: none"> <li>Impacts to air quality: fugitive dust will be controlled by chain link and/or geotextile containment during the harmonic delamination process, in addition to wetting prior to detonation.</li> <li>Impacts to air quality: an operator wetting the structure with a fire hose during mechanical demolition will control fugitive dust. This will result in minor dust generation during the short demolition process. Vehicle and equipment emissions are a potential issue.</li> <li>Impacts to water quality may occur, such as runoff generated during and after dust control.</li> <li>Minimal impacts to soils are expected from dust control, the falling structure and vehicular traffic. No soil contamination is expected, as the facility will meet the unrestricted release criteria prior to demolition.</li> <li>No impacts to wildlife are expected. Efforts will be taken to cordon off the area to wildlife.</li> <li>Resource use is decreased by this method as the demolition duration is expected to be approximately one and half weeks.</li> </ul>
Soils and Geology	-	+	0
Air Quality	-	0	+
Water Quality	-	0	+
Human Health and Safety	-	+	0
Ecological Resources	0	0	0
Historical Resources	0	0	0
Visual Resources	0	0	0
Noise	-	+	0

<sup>9</sup> Each area evaluated, has a narrative row followed by an evaluation of the criteria: + is a positive aspect, 0 is a neutral aspect, and - is a negative impact, indicating the ranking of hazards, impacts, or acceptability

Table 1. Demolition Evaluation<sup>10</sup>

	Mechanical Demolition	Explosive Implosion	Harmonic Delamination and Mechanical Demolition
Structural	<p>This method is technically feasible. Of the three methods evaluated, this is the most labor intensive and purely mechanical machinery brute force.</p> <p>The floor will be removed prior to ceiling and walls, which will act as confinement for the contaminated floor removal. A typical method used for a six sided above grade concrete structure is to destroy one wall at a time until the ceiling collapses. However, this structure is not typical. It is two stories tall with extraordinarily thick walls. These 4 - 5 foot thick reinforced concrete walls will be difficult and time consuming for an excavator mounted ram to break apart and impractical for a shear to be useful other than rebar trimming for chunk separation. A shear attachment is often used on floor or ceilings, but in this case the ceiling thickness and height render this attachment useless, except for the rebar.</p> <p>Therefore, this method requires that nearly 100% of the demolition of the Room 101 structure be performed by an excavator mounted ram. Recent experience with thick concrete slab removal at PACS 1 took approximately 2 weeks to destroy with the advantage of being under the excavator vs. the vertical walls.</p> <p>The falling ceiling poses a distinct safety disadvantage when comparing to the other options.</p>	<p>This method is technically feasible. The mechanical portion of this method consists of drilling only. The explosives do nearly all the work and leave rubble that will be mostly ready for transport. Upon placement and detonation of the explosives, the structure would be 100% on the ground and sized to manageable chunks. Some mechanical separation of the larger rubble chunks from the rebar may be necessary after detonation so that the concrete may be recyclable. If necessary, a combination of shear and ram attachment to an excavator would be used. When compared to the first all-mechanical method, this method relies nearly all on the explosive forces for the demolition. The time to execute this method is about 1/4 of the first method and the schedule reliability is far higher due to the effectiveness of the methodology.</p>	<p>This method is technically feasible and is a combination of the first two. That is, explosives would do the brute force structure demolition, followed by mechanical destruction of the resulting larger sectional pieces. This method utilizes drilling to place explosives, but the advantage over the second method is the reduced particulate emissions by a more sophisticated drilling system. The other large advantage of this method is the designed separation of concrete from rebar by the explosive layout and detonation timing. This gives tremendous advantage in that it brings the structure to the ground, and the resulting sectional elements are already separated from the rebar, without having to disintegrate the concrete into small chunks creating a considerable amount of dust, as in the second method.</p> <p>The separation of concrete from rebar is the most brute force intensive part of reinforced concrete destruction. This methodology has an advantage over the first methodology in that the resulting concrete will nearly all be directly recyclable. The advantage over the second method is significantly lower dust generation, and a controlled dropping of the ceiling.</p> <p>By first dropping the structure to the ground and then mechanically busting up the larger rebar-free sectional pieces with much more direct access than the first method, also allows for more absolute dust control via a hose stream than the second method.</p> <p>Overall, this method is the most efficient, is inherently safer, and has the best opportunity for dust control.</p>
Technique is efficient, safe and responsible	-	0	+

<sup>10</sup> Each area evaluated, has a narrative row followed by an evaluation of the criteria: + is a positive aspect, 0 is a neutral aspect, and - is a negative impact, indicating the ranking of hazards, impacts, or acceptability

Table 1. Demolition Evaluation<sup>11</sup>

	Mechanical Demolition	Explosive Implosion	Harmonic Delamination and Mechanical Demolition
Economic	The cost for mechanically demolishing room 101 is \$118,000 to \$185,000. The average cost is \$151,500.	The cost for explosive demolition of room 101 is \$205,000.	The cost for harmonic delamination and mechanical demolition of room 101 is \$188,000.
Cost	+	-	0

<sup>11</sup> Each area evaluated, has a narrative row followed by an evaluation of the criteria: + is a positive aspect, 0 is a neutral aspect, and - is a negative impact, indicating the ranking of hazards, impacts, or acceptability

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